

Seed Treatment for Corn Diseases

By I. E. MELHUS, C. S. REDDY, W. P. RALEIGH AND L. C. BURNETT.



Untreated
53.5 bu. an acre

Treated
88.4 bu. an acre

AGRICULTURAL EXPERIMENT STATION
IOWA STATE COLLEGE OF AGRICULTURE
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BOTANY AND PLANT PATHOLOGY SECTION
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AMES, IOWA

Summary and Recommendations

In Iowa three destructive corn diseases attack the seed, namely, *Diplodia* dry rot, *Basisporium* dry rot and *Gibberella* dry rot. These dry rots are best known on the ear, but also may attack any part of the plant, including the seed and seedling. The injury to the seed and to the subsequent yield has been measured during the last six years in 25 counties and found to average 5 bushels per acre. These dry rot organisms live over on the old stubble in the soil and on the seed and attack the next season's crop.

The control of the dry rots consists of two phases; (1) protecting the corn plant from infection in the field thru a proper sequence in crop rotation and practicing early selection and artificial curing of the seed; and (2) controlling the seedling blights by ear testing and seed treatment. Ear testing is essential in so far as it involves removing ears with dead and weak kernels. Should the seed be strong but diseased, treatment may replace ear testing.

Experiments to determine the value of seed treatment have been in progress for the past five years. It has been found that the common fungicides, such as formaldehyde, bordeaux mixture, mercuric chloride and others, have not proven of practical benefit and frequently injured the germination of the corn.

The dust fungicides, containing from 3 to 7 percent mercury in somewhat insoluble form, have proven more practical and as efficient in controlling the dry rot diseases as the best liquid treatments. These mercury dusts seem to cause no injury to healthy seed and at the same time kill the dry rot molds on diseased seed. Treating diseased seed may increase the yield very little or may double the yield, depending upon the amount of infection and the growing conditions. Farmers' "planter box corn" when treated with any one of the three dust fungicides now on the market has given an average increased yield varying from about two and one-half to five bushels. Seed treatment shows the greatest value on early planted corn. The dusts seem to protect the seed in cold wet soil in the early spring. Under these adverse conditions treated seed does not seem to rot as quickly as untreated seed.

The three mercury dusts named in this circular will not control corn smut, corn rust, holcus bacterial spot, insect or rodent injury in the field. Neither are these dusts recommended for the control of smut on small grain.

Use two ounces of the dust fungicides per bushel of corn. It is very essential that the dusts be thoroly mixed with the seed. The most practical home device for mixing is a barrel churn revolved slowly 5 to 10 minutes. The mixing must continue until every kernel is thoroly coated to insure best results.

It has been shown that different fillers influence the rate of drop. It is essential, therefore, that the rate of drop be observed and, if some interference is shown, the planter should be calibrated accordingly.

The dust fungicides now on the market that have been tried by the Station and found satisfactory are Merko, Semesan Jr. and Bayer Dust. These dusts retail at about \$1.75 per pound. This means a cost of 3 or 4 cents per acre.

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About 20 years ago seed treatment of corn was prematurely introduced. It failed for lack of knowledge of corn diseases and fungicides.

Investigations in Iowa for the past 12 years show the presence of several destructive diseases of corn and that the three diseases most injurious to the seed are *Diplodia* dry rot, *Basisporium* dry rot, and *Gibberella* dry rot. These three diseases, however, are not confined to the seed only, but are found on all parts of the plant. Often the ears become moldy and unfit for either market or feeding purposes. At the same time, these dry rots may occur on ears without being visible to the eye and yet partially or wholly destroy the vitality of the seed. Our studies have shown that 10 to 14 percent of the seed used in Iowa for the past seven years has been infected with these dry rot organisms. The use of diseased seed causes many of the missing hills and weak plants, which in turn often reduce the yield. In 1922 a circular (78) was issued by this station describing the use of the germinator to eliminate *Diplodia* infected ears. During the past seven years this practice has grown extensively.

Five years ago our attention was directed to seed treatment as a possible further means of combatting the dry rots in seed and protecting the seedling corn plant in its early stages of growth in the spring. It is the purpose of this circular to describe briefly three of the common diseases of corn and to relate some of the results of our experiments on seed treatment of corn.

Losses Due to Dry Rots in Iowa

The dry rots of corn cause annually a considerable loss to the corn grower frequently much more than is appreciated. The dry rot fungi, besides damaging the ears, also weaken the stalks and ear shanks and cause seedling blights. Estimates of losses made by the authors beginning in 1921 are listed in table I. It will be noted that, during the last seven years, the damage has ranged from 4 to 10 percent of the total crop.

TABLE I. LOSSES CAUSED BY THE DRY ROTS IN IOWA; 1921 TO 1927, INCLUSIVE.

Year	Percent loss	Bushels loss
1921	4	17,767,000
1922	4	19,384,000
1923	9	46,652,000
1924	7	24,265,000
1925	10	56,975,000
1926	7	52,760,000
1927	7	29,680,000*

*November yield estimate, Iowa State Department of Agriculture.

Such losses, as are shown in table I, would be a shock to the people of the state, if it were not for the fact that they occur every year and, therefore, are accepted as a matter of course. Control of losses, like these, offers one of the best means of reducing the cost of production, and thus increasing farm profits.

Some further conception of the loss due to the use of dry rot infected seed can be gained from the following five-year summary of experiments in which healthy and diseased seed, as determined by germinator tests, were planted in 25 different counties. The plan of the trials was as follows. In general, each of 10 farmers in a given county furnished 100 seed ears (in some cases the number was reduced to 50) and from each lot 10 healthy and 10 diseased ears were selected. The healthy ears showed no signs of mold and six kernels from each ear tested produced good strong sprouts on the rag doll germinator. The *Diplodia* dry rot infected ears selected the first year were those which showed an average of one dead and two weak diseased kernels. Later, only those ears were chosen in which all the kernels were alive, but showed one to three diseased. It should be emphasized that the *Diplodia* dry rot infected ears were to all outward appearances good seed ears, showing no visible signs of infection. The corn in this diseased sample appeared as good, judging from all superficial characteristics, as the healthy sample.

The samples of healthy and diseased corn were prepared for planting by shelling each 10 ear lot separately, which gave one lot of healthy and one of diseased from each sample supplied by the farmers. In addition, each farmer furnished a pint of shelled seed corn from that which he had prepared for his own planting. This was designated as "farmers' seed corn." The above samples were planted by hand, three kernels per hill, except in Sioux County, where four kernels were used. Three replications were planted from each sample and the average of the three taken in computing the yield.

In addition to the reduction in stand, it was very noticeable that the rows planted with diseased seed had a high percentage of weak stunted plants, which either died or were so weakened that they reduced the yield. Similar conditions were noted in the rows planted with "farmers' seed corn," but to a lesser degree.

The stand in the rows planted with healthy seed was not perfect, due to several factors, such as dry weather at planting time, insects and other influences. The effect of these factors, however, was evenly distributed on all three lots.

The data in table II show field stand percentages in which the one from healthy seed is 10.4 higher than that from diseased seed and 4.4 higher than that from farmers' seed. A similar compari-

TABLE II. A SUMMARY OF FIVE YEARS' DATA ON FIELD PERFORMANCE OF CORN FROM HEALTHY AND DISEASED SEED AS DETERMINED BY THE MODIFIED RAG DOLL.

Factors	Healthy	Diseased	Farmers'	Difference between healthy and	
				Diseased	Farmers'
Percent stand	77.20	66.80	72.80	10.40	4.40
Percent barrenness	5.15	7.35	6.0	2.20	0.85
Percent nubbins	10.00	13.20	12.50	3.20	2.50
Yield bu. per acre	63.80	54.50	58.80	9.30	5.00

son of yields shows the yield from healthy seed 5.0 bu. higher than from farmers' "planter-box corn." The differences in yields are probably the total effect of differences in stand, barrenness and size of ears. Other tests for the five-year period made in connection with these experiments showed that an average of 13.6 percent of the ears as selected by farmers for seed were infected with some of the destructive molds or dry rot organisms. These figures show that it is a profitable practice for the corn grower to eliminate the diseased seed from his seed corn.

Diplodia Dry Rot*

Diplodia dry rot occurs on all parts of the plant, including ears, stalks and roots. The mold reduces the stand by killing or weakening the seed corn, and by dwarfing the plants. Later, it molds the ears so that they are unfit for feed or seed.

SIGNS OF DIPLODIA DRY ROT

Diplodia dry rot is most prevalent on the joints of the stalks and the butts of the ears.

On the stalks—The most common points of attack on the stalk are the lower joints where the base of the leaf blade forms a cavity in which pollen and moisture readily collect. Spores of the Diplodia mold lodge in this cavity and grow into the stalk, producing a water-soaked, discolored appearance on the green stalk extending above and below the joint. Continued growth of the mold often weakens the stalks until they break over and the result is excessive lodging in the fields.

Diplodia dry rot is most marked and easily detected on the joints and ear shanks when the crop is mature. At this time, the small black fruiting bodies of the Diplodia mold become very numerous and distinct. In these black bodies, thousands of very tiny spores are produced (fig. 1), which are discharged the following year and attack the new crop.

On the ear—If the shank becomes infected, the ear may be either shrunken and shriveled or badly molded at the butt. This latter condition is usually the result of the entrance of the mold

*Durrell, L. W. Dry Rot of Corn. Iowa Agr. Expt. Sta. Res. Bul. 77. 1923.

at the base of the ear. In other cases, the *Diplodia* mold may enter at the tip of the ear, producing a white, moldy appearance. In still other cases,

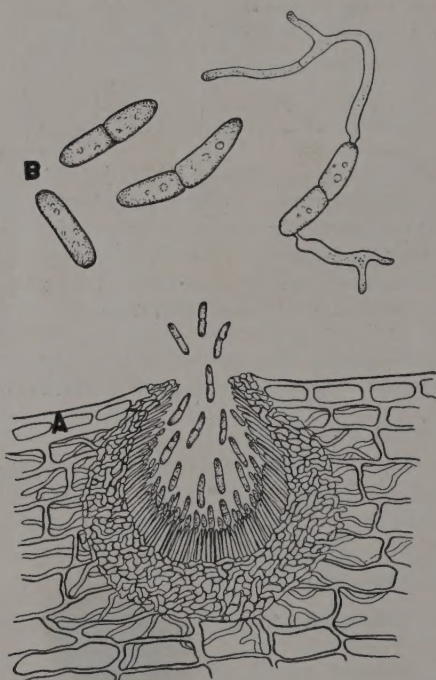


Fig. 1. The *Diplodia* dry rot fungus, showing its methods of spore production and their subsequent growth and development. The spores of this mold are borne in little black cases. A shows the interior of these cases and B the spores before and after germination.

many infected ears show no signs of the mold on the outside, altho its presence may be suspected by badly shrunk and discolored kernel tips. In such cases, the mold can be detected with certainty only thru germination tests. On the germinator, the presence of the *Diplodia* fungus is manifested as a white or dirty white cottony mass, covering the kernels.

Little *Diplodia* infection occurs on the roots, and damage to the plant in that way is negligible. Many organisms are present in the soil which work on corn roots, especially after such insects as corn root worms and wire worms, or high winds have injured them. These organisms are secondary and usually cause little damage if proper rota-

tions are maintained. It is such conditions that constantly suggest the idea of "root rot," which should not be confused with the dry rots under discussion.

Basisporium Dry Rot*

Basisporium dry rot, another important disease of corn, attacks the ears and shanks, frequently causing the ears to lose 20 percent of their normal weight. It also injures the germ of the kernels, thereby reducing the stand and producing weak plants. The disease is caused by a fungus, *Basisporium gallarum*, which is present in corn fields to some extent every year. In the 1927 season, it was unusually prevalent in Iowa.

*Durrell, L. W. *Basisporium Dry Rot of Corn*. Iowa Agr. Expt. Sta. Res. Bul. 84. 1925.

SIGNS OF BASISPORIUM DRY ROT

Infected ears can be recognized by shredded shanks with blackening of the cob around the kernel tips. Also, the kernel tips may be blackened. This color symptom is due to the great number of glossy black spores dispersed over the infected parts. With an ordinary pocket magnifying glass these spores can readily be seen, appearing as small, shiny, black balls. (See spores and mold threads, or hyphae, in fig. 2.)

The mold grows as a fine web of threads not easily visible to the unaided eye. The connective tissue of the ear shank is largely destroyed, leaving only the vascular fibers; ears break off easily and the butt of the cob has a brushy appearance (fig. 3). On the germinator, infected kernels are sometimes dead, often weak, and the tips may be blackened by the fungus. The development of *Basisporium* dry rot is favored by heavy rainfall at the end of the growing season. Temperature is not so important as moisture for the growth of this mold. It grows at any temperature between 60° and 95° F.

The mold does not attack the roots nor grow up inside of the stalk. It probably gains entrance under the husk and thence into the butt of the ear. The mold follows the moister parts of the ear, the cob and kernel tips, and in varying degrees attacks the latter. *Basisporium* mold grows better on nitrogenous than on starchy material, hence the germ is more subject to attack than the endosperm.

On account of their light weight and loose kernels, badly infected ears are rarely selected for seed, but slightly infected ears frequently get on the seed rack. These ears are difficult to detect, altho germination tests aid in eliminating them.

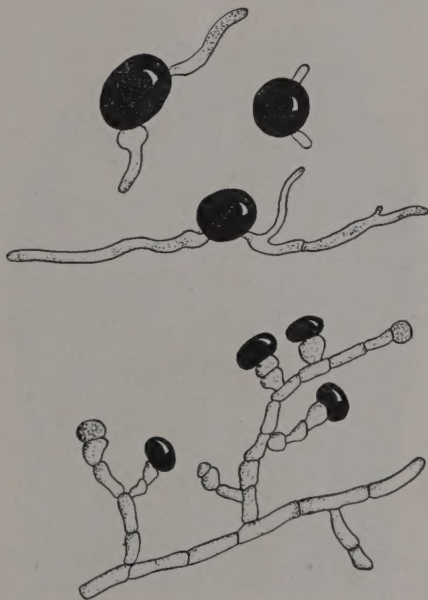


Fig. 2. The *Basisporium* dry rot fungus showing spores and mycelium. The spores are shiny and black; the mycelium is ashy gray as it appears on the tips of the kernels.

Gibberella Dry Rot

This parasitic organism (*Gibberella saubinetii*), like the *Diplodia* dry rot organism, causes seedling blight and ear rot.

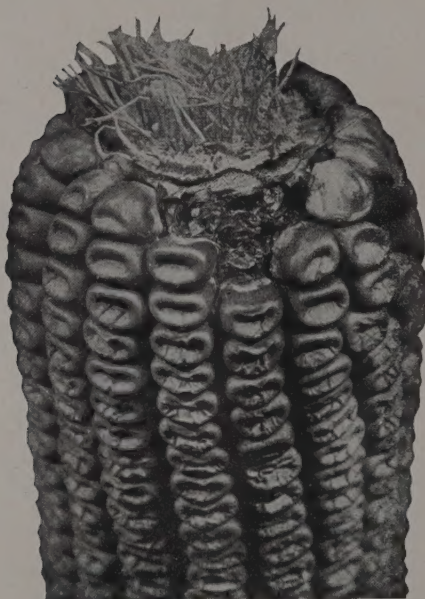


Fig. 3. Butt of ear infected with *Basissporium gallurum*. Note brushy ends of fibers and black spores of fungus on cob and chaff.

However, the same organism is probably better known as the cause of wheat scab. Because the two crops are affected by the same parasite, it has been observed that corn usually does not do so well on fields that have just grown a badly scabbed wheat crop and that wheat following corn is likely to have more scab than wheat following some other crop.

The disease may affect practically any part of the plant, stalk, roots and ears, but does not cause a general infection of the whole plant. Fig. 4 shows *Gibberella* dry rot on the ear. The parasite lives over on the seed and in soil or crop refuse. Its spores are

wind-borne and find a favorable place for growth inside the leaf sheaths, especially at the joints and also on the shanks and ears. The form and structure of *Gibberella* is shown in fig. 5. This disease is not as prevalent and destructive in Iowa as *Diplodia* and *Basissporium* dry rots, but, like the former, the ears may be so lightly infected that they are difficult to detect except on the germinator. Early planting, followed by cold weather, results in poor stands and seedling blight when infected seed is used.



Fig. 4. *Gibberella* dry rot on the ear.

The organism may be distinguished from *Diplodia* and *Basisporium* on the germinator by the color of the cottony tuft surrounding the seed. This may vary from a slight pink to a dark red, often with a tinge of yellow some place in the mycelial mass. Dead kernels on the germinator are red, while those killed by *Diplodia* or *Basisporium* are black. The mycelium of *Diplodia* is at first white, later becoming darker, and, in *Basisporium*, it is never cottony—always sparse and dark gray associated only with the tip of the kernel.

Control of the Three Dry Rots

From the discussion, it is apparent that effective control measures must be directed at two points in the life history of the dry rot organisms. First, prevention of stalk and ear infection, and second, elimination of infected seed. Little progress has been made on the first problem, but substantial advances have been made on the second by using the modified rag doll tester. In circular No. 78 of this station, the value of the modified rag doll in detecting *Diplodia* dry rot infected ears has been de-

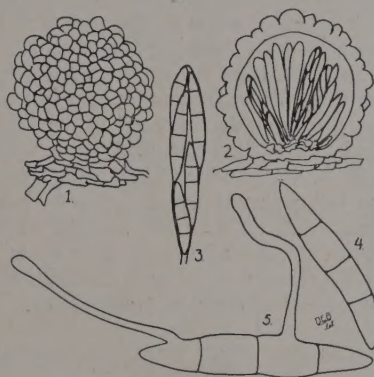


Fig. 5. The organism causing *Gibberella* dry rot is *Gibberella saubinetii*. 1. Spore case or perithecium. 2. Section thru perithecium. 3. Ascus containing ascospores. 4. Ascospores. 5. Ascospores germinating.

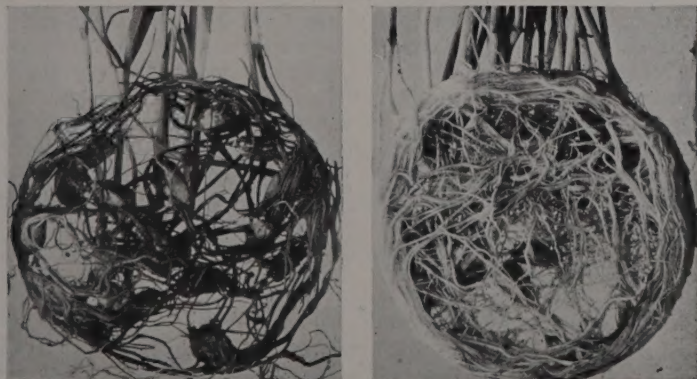


Fig. 6. At the left is shown root growth of seed not treated; at the right, root growth of treated seed.

scribed. The practicability of this method has been abundantly demonstrated during the past five years. This circular presents another and more advanced method of eliminating the dry rot organisms from the seed by the use of seed treatment. A brief discussion of some of the data relating to seed treatment and its place in corn growing follows.

In 1923, efforts were begun to find a fungicide that would kill the dry rot organisms on and inside the kernels without injuring the normal development of the corn plant. This led to many trials in 1923, 1924 and 1925 with the common fungicides, as well as many other chemicals thought to have merit. In 1925, the list was narrowed down to bordeaux mixture, uspulun and formaldehyde soak treatments. Three lots of seed were selected, one of good seed nearly free from dry rots, a second lot of fair seed having some dry rot, and a third lot of poor seed showing considerable disease (table III).

TABLE III. CORN SEED TREATMENT TRIALS AT THE IOWA STATION IN 1925, USING GOOD, FAIR AND POOR SEED.

	Yield in bushels per acre		
	Good seed	Fair seed	Poor seed
Dry, Check (no treatment)	88.2	77.3	67.8
Presoaked 2 hrs. water			
Wet, check (no treatment)	85.8	76.8	68.3
*Bordeaux mixture paste	85.3	79.5	70.2
Uspulun (0.25 percent soak for 1½ hr.)	89.0	79.6	72.5
Formaldehyde (1 pt. in 15 gallons water for 2½ min. at 125° F. and covered 1 hr.)	83.0	72.0	63.5

*The bordeaux mixture paste was made by dissolving one pound each of blue stone (copper sulphate) and burned lime (calcium oxide) separately in one gallon of water. The bordeaux mixture was made by pouring these two solutions simultaneously into a third container. The corn was soaked for a few minutes in this paste and then allowed to dry before planting.

In table III, it is shown that the common fungicides, such as formaldehyde and paste bordeaux mixture, were injurious to good seed when used in concentrations strong enough to control the organisms on diseased seed. The organic mercury liquid treatment did not injure good seed and increased the yields from diseased seed from 2 to nearly 5 bushels. Soaking the seed in water before planting decreased the yield on good seed, which suggested that a dry treatment would be better if one could be found. Soaking the seed is objectionable from the standpoint of the planter drop. As a result, a large portion of the seed treatment experimentation in 1926 was with organic mercury dust fungicides.

Summary of 1926 Results

In 1926, six mercury dust treatments and three liquid treatments were tested on nearly disease free and *Diplodia* dry rot

TABLE IV. RESULTS OF CORN SEED TREATMENT TRIALS AT THE IOWA STATION; 1926.

Treatment	Yield in bushels per acre	
	Nearly disease free	Diplodia infected seed
Check (no treatment)	60.2	40.9
*S.F.A. 225 (dust) 2 oz. per bu.	61.3	52.2
**13 U.G. (dust) 2 oz. per bu.	61.6	50.7
Semesan Jr. (dust) 2 oz. per bu.	59.9	52.2
Bayer Dust (dust) 2 oz. per bu.	59.8	51.6
***12 Bel (dust) 2 oz. per bu.	60.1	53.4
*Abavit B (dust) 2 oz. per bu.	60.4	47.7
Mercuric Chloride Soak (1-3000)	58.4	49.3
Uspulun Soak (1-200)	59.5	54.5
Semesan Soak (1-200)	60.6	52.2

*German products not on the market in this country.

**This was double strength of Semesan Jr.

***An experimental dust supplied by E. I. du Pont de Nemours Co., Wilmington, Delaware.

infected seed corn. The "nearly disease free" seed was from ears selected by means of germinator tests. There was therefore little diseased seed in such a lot. It is called "nearly disease free" because there was always the possibility that some diseased kernels were not detected. It is noteworthy that all of the treatments, both soak and dust, increased markedly the yield from the diseased seed as shown in table IV. Little or no injury to the "nearly disease free" seed was evident, except in the case of mercuric chloride. The best dust treatments gave practically as good results as the best liquid treatments. The dust treatments present many advantages to the corn grower, as compared to the liquid treatments, because they are much more easily applied and there is less danger of injury to the seed before it is planted. With liquid treatments, care must be taken that the seed is properly dried before it is planted. Also the dust fungicides probably offer more protection to the seed from molds in the soil than the liquid treatments.

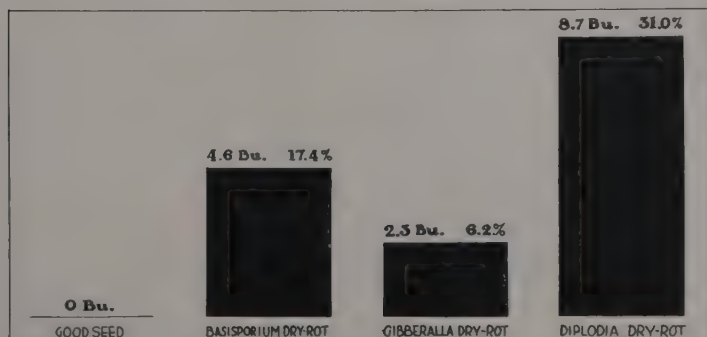
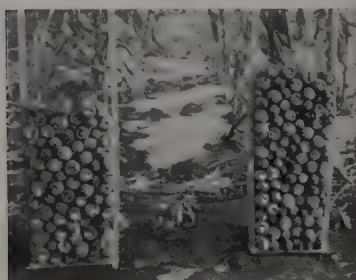


Fig. 7. Average increase from treating four lots of seed corn with three commercial dusts. (Data from table V.)

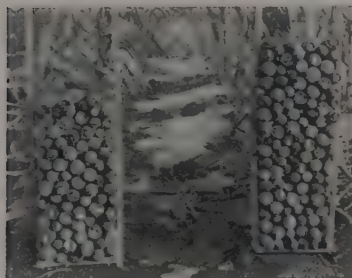
Trials With Dust Fungicides on Healthy and Diseased Seed in 1927

In 1927, still further field trials were made using seed infected with *Diplodia*, *Basisporium* and *Gibberella* dry rot parasites, in comparison with good seed. The field used for this purpose was one adjoining the Agronomy Farm, Ames, Iowa; a field in only a fair state of fertility. This is evident from the response of the good seed, which yielded slightly less than 35 bushels per acre. Stand and yield data were obtained by growing 10 replications of 30 hills each. Only the summarized yield data are presented in table V and figs. 7, 8, 9 and 10. No comparison can be made between the yields of the different lots (I, II,



Untreated Treated
26.5 bu. per A. 31.0 bu. per A.

Fig. 8. Illustration of average yields of 10 plots from untreated, and of 3 sets of 10 plots from treated *Basisporium*-infected seed, the 3 sets treated respectively with Merko, Bayer Dust and Semesan Jr., Ames, Iowa, 1927. (Data from table V.)



Untreated Treated
28.1 bu. per A. 36.5 bu. per A.

Fig. 9. Illustration of average yields of 3 sets of 10 plots from Bayer Dust treated *Diplodia*-infected seed. (Data from table V.)

III and IV) because the lots were not all grown on soil of the same fertility. It is significant, however, that all three of the commercial dusts increased the yield of the diseased seed irrespective of the kind of dry rot concerned. In the case of the good seed, there were no significant increases or decreases. The slight reduction in yield from good seed, in the case of Semesan Jr., may well be within the range of experimental error. It seems evident that these three dusts will materially benefit diseased seed without injury to good seed. (See fig. 6.)

Results With Dust Treatment on Farmers' "Planter Box Corn"

In the experiments described previously, the seed corn was especially selected in some instances for the presence of considerable disease. This was necessary in order to measure accurately the efficiency of the dust fungicides in controlling disease. The final test as to the value of a dust fungicide for corn is its effect on the yield of farmers' "planter box seed



Untreated
28.1 bu. per A.

Treated
36.1 bu. per A.

Untreated
28.1 bu. per A.

Treated
37.8 bu. per A.

Fig. 10. (On left) Illustration of yields from Diplodia-infected seed. Untreated and treated with Semesan Jr. (Data from table V.)

(On right) Illustration of average yields of 3 sets of 10 plots from Merko treated Diplodia-infected seed. (Data from table V.)

corn." A dust fungicide must be able to increase the yield from seed selected and prepared for planting by the average farmer, in order to have a place in agricultural practice. In the county tests with corn, which have been continued since 1922, it has been demonstrated that the average "planter box corn" ("Planter box corn" is used here to mean such seed as is planted generally by the corn grower in Iowa) yields less than "nearly disease free" seed by 5.0 bu. per acre. This is evidence that "planter box corn" is a composite of healthy and diseased seed with the latter in the minority. The estimates of losses due to dry rots, as presented in another part of this circular, are largely based on (1) the amount of dry rot in farmer's seed as evidenced by germination tests, and (2) the average difference in the yields between "nearly disease free" and farmers' "planter box corn."

In 1927, a series of county test plots were planted, in which certain dusts were used on "planter box corn." A total of 15

TABLE V. SUMMARIZED RESULTS OF EXPERIMENTS WITH COMMERCIAL DUST FUNGICIDES ON FOUR LOTS OF SEED CORN, AMES, IOWA, 1927.

Treatments	Acre yield in bushels							
	Lot I Good seed		Lot II dry rot Basisporium		Lot III dry rot Gibberella		Lot IV dry rot Diplodia	
	Actual yield	Inc. over check	Actual yield	Inc. over check	Actual yield	Inc. over check	Actual yield	Inc. over check
Check (no treatment)	34.7		26.5		37.2		28.1	
Bayer Dust 2 oz. per bu.	34.8	0.1	31.7	5.2	38.5	1.3	36.5	8.4
Semesan Jr. 2 oz. per bu.	34.4	-0.3	30.6	4.1	...	..	36.1	8.0
Merko 2 oz. per bu.	34.9	0.2	30.9	4.4	40.4	3.2	37.8	9.8

plots were planted, but only 11 were harvested. One round of the planter, or four rows, was planted across the field for each dust as well as for each check. In most cases, there were three checks, one at each side of the plot and one thru the middle. Within a month after planting, counts were made to determine the effect on stand. The plots were usually a part of a large corn field and received the same care as the entire field. Every effort was made to meet ordinary farm practice and to have the trials on a large enough scale to approach field conditions.

Harvesting of the plots was carried out by husking a total of 200 hills from each treatment and check. The 200 hills were not gathered in one place, but consisted of 40 hill blocks taken in five different places extending in each case entirely across each set of plots. In table VI is given the effect of three commercial dusts.

The data from only five counties are recorded because in the other cases new dusts not yet on the market were in the tests. The five county trials show the results with the three dusts now offered for sale.

It should be noted from table VI that the stand was generally increased by treatment. The difference in the stands was large enough in each case to give a general increase at harvest time. Increased yields, due to treatment, were not always the same, but varied from less than one to more than six bushels per acre. These data from plots in five counties with five different farm-

TABLE VI. FIELD STANDS AND ACRE YIELDS FROM TREATED AND UNTREATED "PLANTER BOX CORN" GROWN IN 5 COUNTIES IN IOWA, 1927.

Location of plots	Merko			
	Treated		Check no-treatment	
	Stand	Yield	Stand	Yield
O'Brien County	1012	50.8	982	44.9
Clay County	1331	32.0	1235	27.2
Shelby County	1092	77.2	1075	72.6
Cerro Gordo County				
Boone County	1099	60.1	1042	57.2
Bu. increase in acre yields		4.55		
	Bayer Dust			
	Treated		Check no-treatment	
	Stand	Yield	Stand	Yield
O'Brien County	1008	46.8	982	42.8
Clay County	1338	24.1	1235	21.1
Shelby County		82.4		78.2
Cerro Gordo County	856	34.4	771	30.8
Boone County				
Bu. increase in acre yields		3.70		
	Semesan Jr.			
	Treated		Check no-treatment	
	Stand	Yield	Stand	Yield
O'Brien County	851	48.1	982	48.2
Clay County	1041	33.9	1235	27.2
Shelby County	1092	78.4	1075	76.4
Cerro Gordo County				
Boone County	1047	59.6	1042	59.4
Bu. increase in acre yields		2.20		

TABLE VII. INFLUENCE OF FILLERS ON "RATE OF DROP" AS DETERMINED BY FIELD STANDS, IOWA, 1927.

Location of plot	Check	Talc filler	Lime filler (Calcium)
Boone (Mott)	1042	1053	984
Greene (Smith)	1674	1729	1615
Shelby (Anderson)	1075	1092	1048
Fremont (Wiedor)	1656	1648	1645
Fremont (Oppenheimer)	1049	1079	1025
Pottawattamie (Greene)	1048	1043	852
Pottawattamie (Rushenberg)	394	369	341
Harrison (Lewis)	840	751	722
Buena Vista (Hadenfeldt)	1023	983	934
O'Brien (Nelson)	982	965	884
Clay (Jensen)	1235	1254	1186
Cerro Gordo (American Sugar Beet Co.)	771	799	690
Black Hawk (Tanreuther)	798	796	750
Webster (Steiner)	513	477	525
Wright (Melhus)	703	656	560
	14803	14694	13761

ers' seed, together with the other data recorded in this circular, warrant the general statement that seed treatment of farmers "planter box corn" usually results in increased stands and yields.

Relation of Dusted Seed to "Rate of Drop"

In connection with the experiments made in 1926, it was learned that, in some cases, the dusted seed did not run thru the planter box as well as that not dusted. This led to trials in 1926 and 1927 using two of the common dust fungicide fillers. (The filler is the inert material in the dust fungicides.) Fillers were applied at the same rate as the dust fungicides, namely, two ounces per bushel. In 1927, an experimental plot was located in each of 13 counties. In Fremont and Pottawattamie there were two plots each instead of one, however. The plots were planted in the farmers fields with the seed and planter he was using at the time.

The difference in the stand just before corn cultivating started was used to measure the difference in the drop for the check and two fillers, talc and lime (calcium). Both edge and hill drop planters were used in these different county tests. The data obtained are shown in table VII. The total stand in 15 plots from seed that was not dusted was 14,803; seed dusted with talc filler 14,694; and, with lime filler, 13,761. The reduction in stand due to the talc filler was less than 1 percent (actually 0.7 percent), to the lime (calcium) filler 7.0 percent. These data make it clear that the filler in the dust fungicide may have an appreciable effect on the planter drop of the seed. It would be well, therefore, to watch carefully the rate of drop and adjust the machine to compensate for the difference, if one is discovered. Otherwise, the benefit from treatment might be lost by a reduction in initial stand.

Applying the Dusts to Seed Corn

Each kernel should be thoroly coated with the dust before planting, in order to get the best results. This can be accomplished only by thoro mixing of the dust with the seed. Success or failure of seed treatment lies, very largely, in the thoroness of the mixing. As a rule, it requires from 5 to 10 minutes to thoroly coat the seed.

Some rotating device, as a churn or small barrel with a gas pipe run thru the two heads and set in a frame may be used for coating the seed. Smaller lots can be well mixed by shaking in a milk can having a tight lid. It should be remembered that seed corn dust fungicides now on the market all contain mercury as the active ingredient. Mercury is very poisonous. The following precautions are recommended.

1. Mix the dust with the seed in a tightly closed container.
2. If the air becomes dusty, tie a wet handkerchief over the nose and mouth.
3. Treated seed should be kept away from children and should not be fed to livestock.
4. Treated seed should be labeled "poison".

Dust Fungicides for Corn on the Market

Three companies offer seed corn dust fungicides for sale on the market. The active ingredient in all of these is mercury, ranging from about 3 to 7 percent, mixed with some inert filler. The present price to the farmer is about \$1.75 per pound. In each case only 2 ounces are required per bushel, which makes the cost per acre for seed treatment material about 3 cents. The labor cost involved in treating the seed is also very low, especially when it is realized that the treating can be done any time during the slack season of the year. The products on the market that have been tested by the station and found satisfactory are:

Bayer Dust—Bayer Company, Inc., New York.

Merko—Pittsburgh Plate Glass Co., Corona Chem. Div., Milwaukee, Wis.

Semesan Jr.—E. I. DuPont de Nemours Co., Wilmington, Delaware.